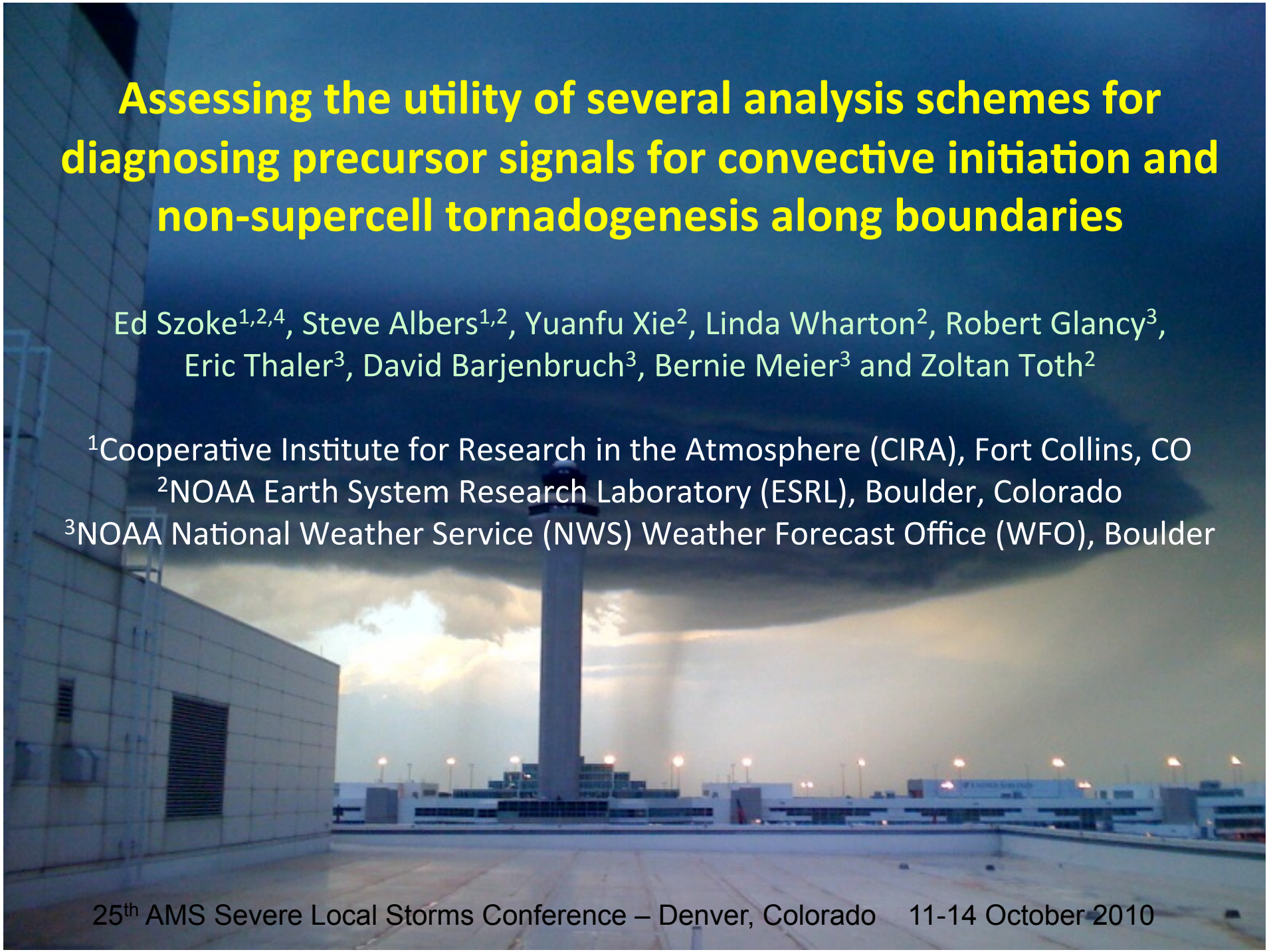


Assessing the utility of several analysis schemes for diagnosing precursor signals for convective initiation and non-supercell tornadogenesis along boundaries

Ed Szoke[1,2,4], Steve Albers[1,2], Yuanfu Xie[2], Linda Wharton[2], Robert Glancy[3], Eric Thaler[3], David Barjenbruch[3], Bernie Meier[3] and Zoltan Toth[2]

[1]Cooperative Institute for Research in the Atmosphere (CIRA), Fort Collins, CO
[2]NOAA Earth System Research Laboratory (ESRL), Boulder, Colorado
[3]NOAA National Weather Service (NWS) Weather Forecast Office (WFO), Boulder

25th AMS Severe Local Storms Conference – Denver, Colorado 11-14 October 2010

Analyses – any value today?

- With all the realistic model forecasts at fine scale, is there a role left for a real-time analysis at the WFO?
  - I would say yes…
    - Nowcasting
      - Situational awareness
      - Fill in the short-term gap of model spin-up of convection
    - Truth checking the models
      - Trying to avoid "convective scale meteorological cancer"
    - Initialize "local scale" model

Purpose of this study

- LAPS is evolving
  - LAPS has been on AWIPS as a local (~WFO-scale) 3-D analysis since ~late 1980s
    - Originally 10 km resolution, now 5 km (< 5 km at some WFOs)
    - Uses multi-scale successive corrective techniques with liberal QC
    - Philosophy – use all available data and must run quickly
  - New types of LAPS
    - Higher resolution – down to 1 km horizontal grid resolution
    - Many scales – local to global
    - Different analysis scheme
      - STMAS (Space-Time Mesoscale Analysis System)
        - Like LAPS but uses a multigrid technique combining the effects of EnKF and 4DVAR
        - Running to national scale at 2 km resolution (FAA project) Regional to 1 km

Paid advertisement to follow…

ESRL/GSD will be hosting the

1st LAPS User's Workshop

- where: Boulder
- when: 25-27 October 2010

see laps.noaa.gov

Purpose (continued)

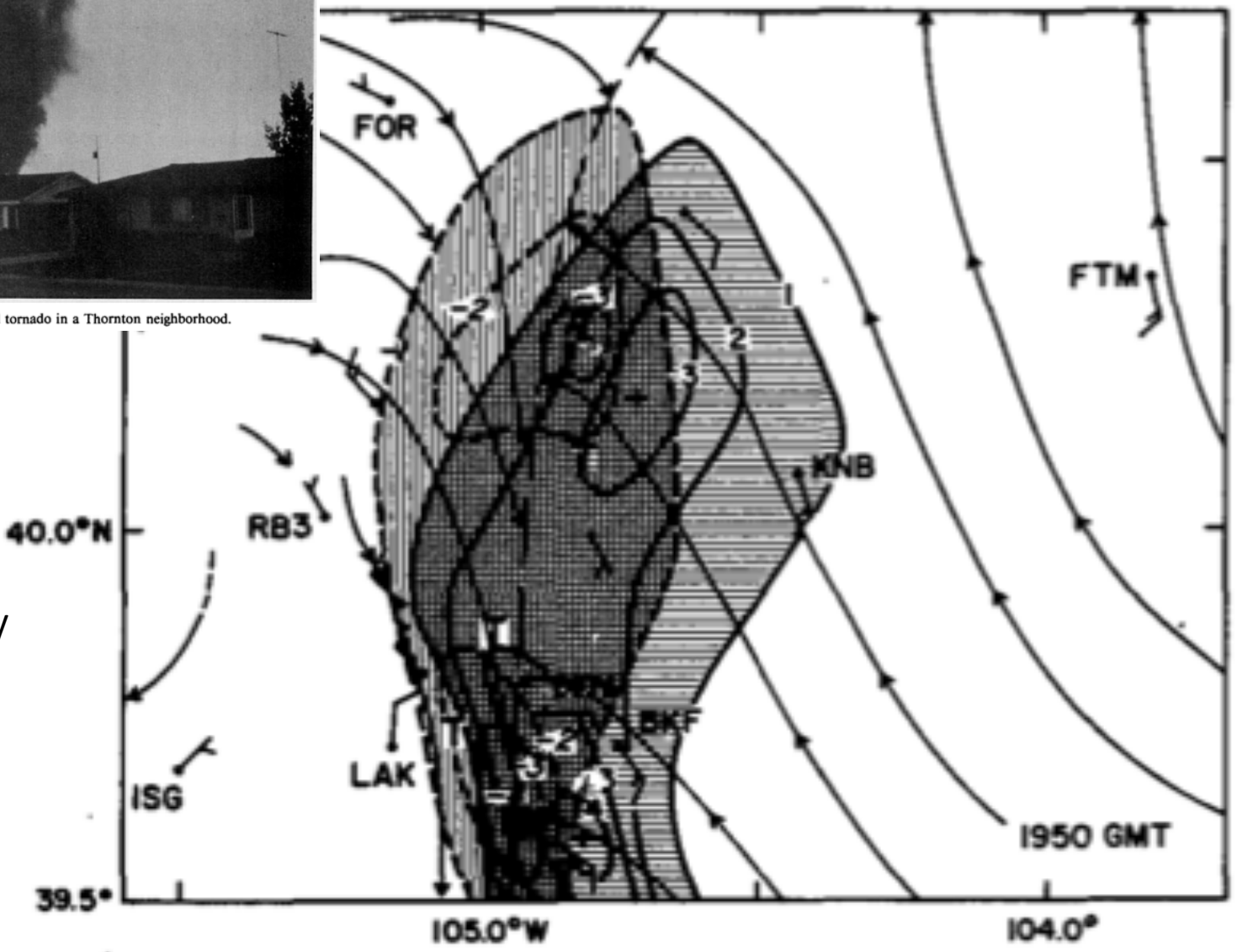
- Given the various changes want to see how the analyses compare
  - Case study approach part of this
    - For this work looked at interesting boundary cases
    - Today will show 2 tornadic DCVZ cases
  - Compared LAPS at 5 and 1 km horizontal grid resolution with STMAS at 5 km
    - Since have STMAS at 2 and 1 km – not shown today
  - Also compared with RTMA (5 km) and HRRR 0h (3 km)
    - To be fair….
      - RTMA primary purpose is an Analysis of Record, also now at 2.5 km
      - HRRR analysis at this time from 13 km RUC
        - So may not have smaller scale features, though could be in forecast
- Fields we focused on…

??? – Manual calculation and analysis of vorticity and convergence along the DCVZ

FIG. 18. Photograph of the second tornado in a Thornton neighborhood.

From MWR (1984), 3 June 1981 Denver tornadoes

Hand analyses by Fernando Caracena using time-space conversion



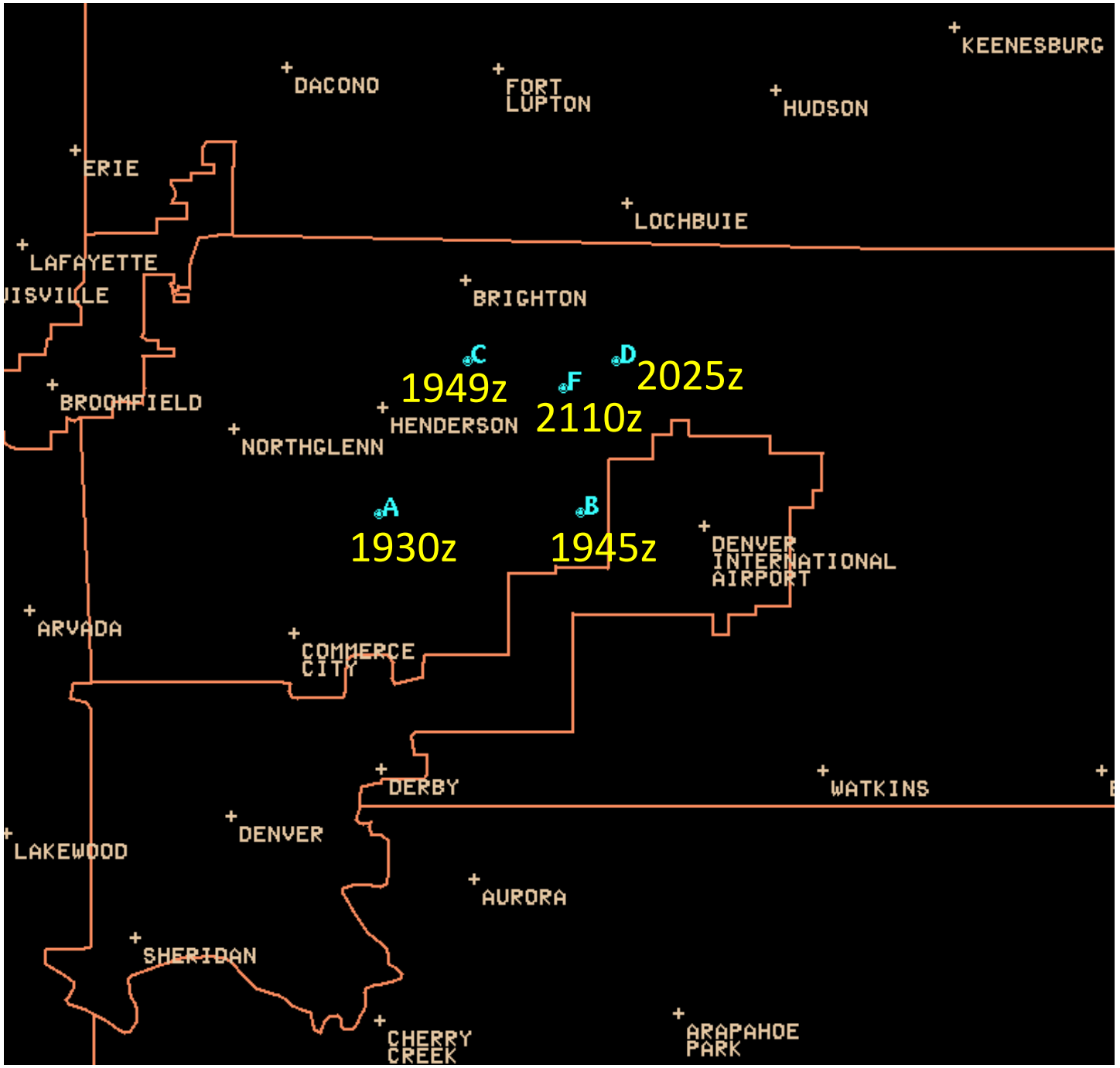
Things we hoped to do but didn't (yet?)

- Compare analyses using the "NST Parameter"
  - NST = NonSupercell Tornado parameter
    - Developed by Dan Baumgardt at La Crosse WI WFO
    - Presented at 23rd SLS Conference
    - Used combo of LAPS fields to improve situational awareness for boundaries that might be more prone to non-supercell tornado development
  - Wanted to get the new LAPS and STMAS analyses onto AWIPS at the Boulder WFO
    - Were available in real-time on the web

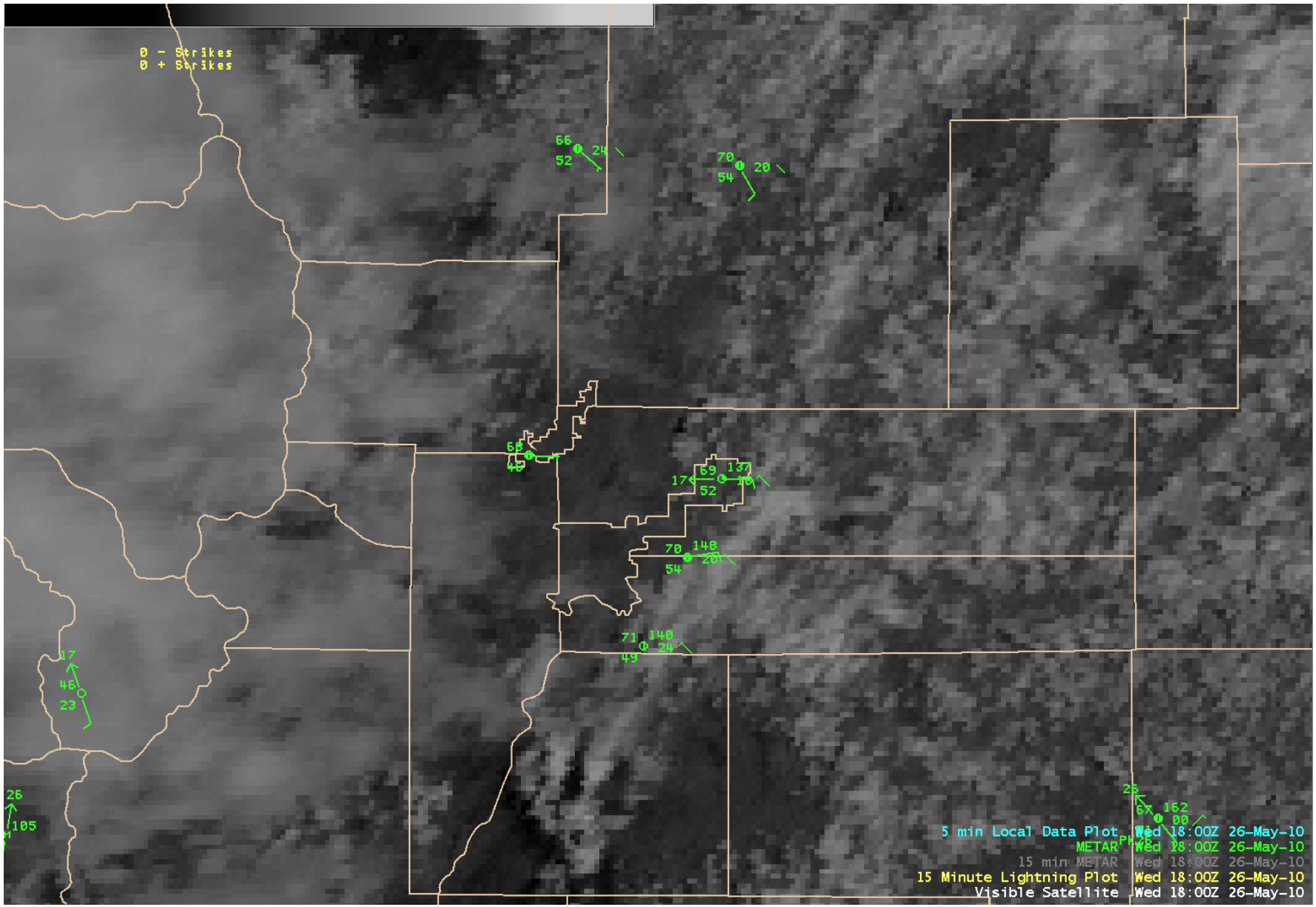
Case 1: 26 May 2010 – strong storms develop on the DCVZ near DIA (pre VORTEX-2 part)

Approximate locations of the tornado reports

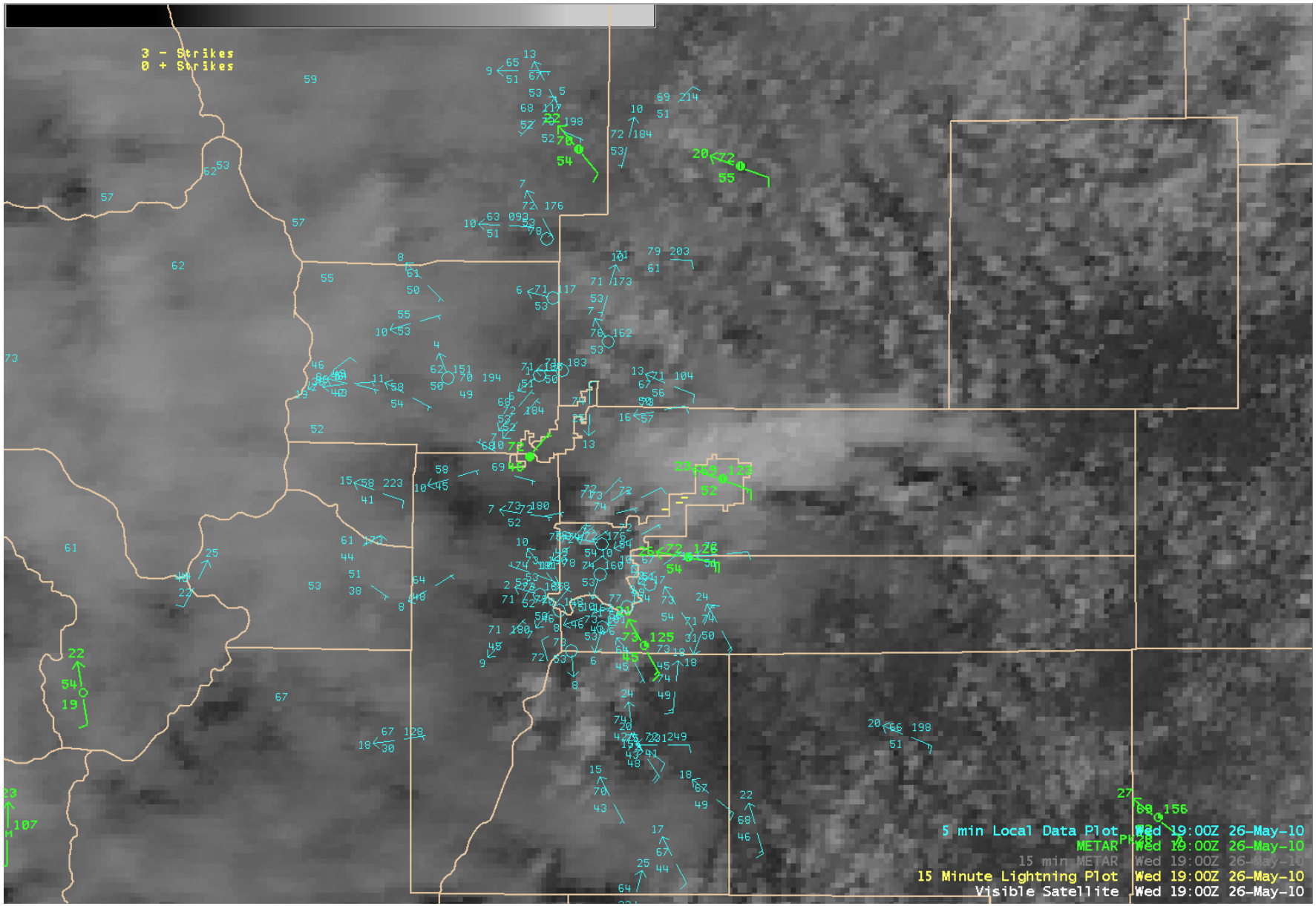
5 tornadoes?
Or none?
Officially one
(then another in
Weld County that
is not shown here)



Storm overview – Vis image and obs at 18z

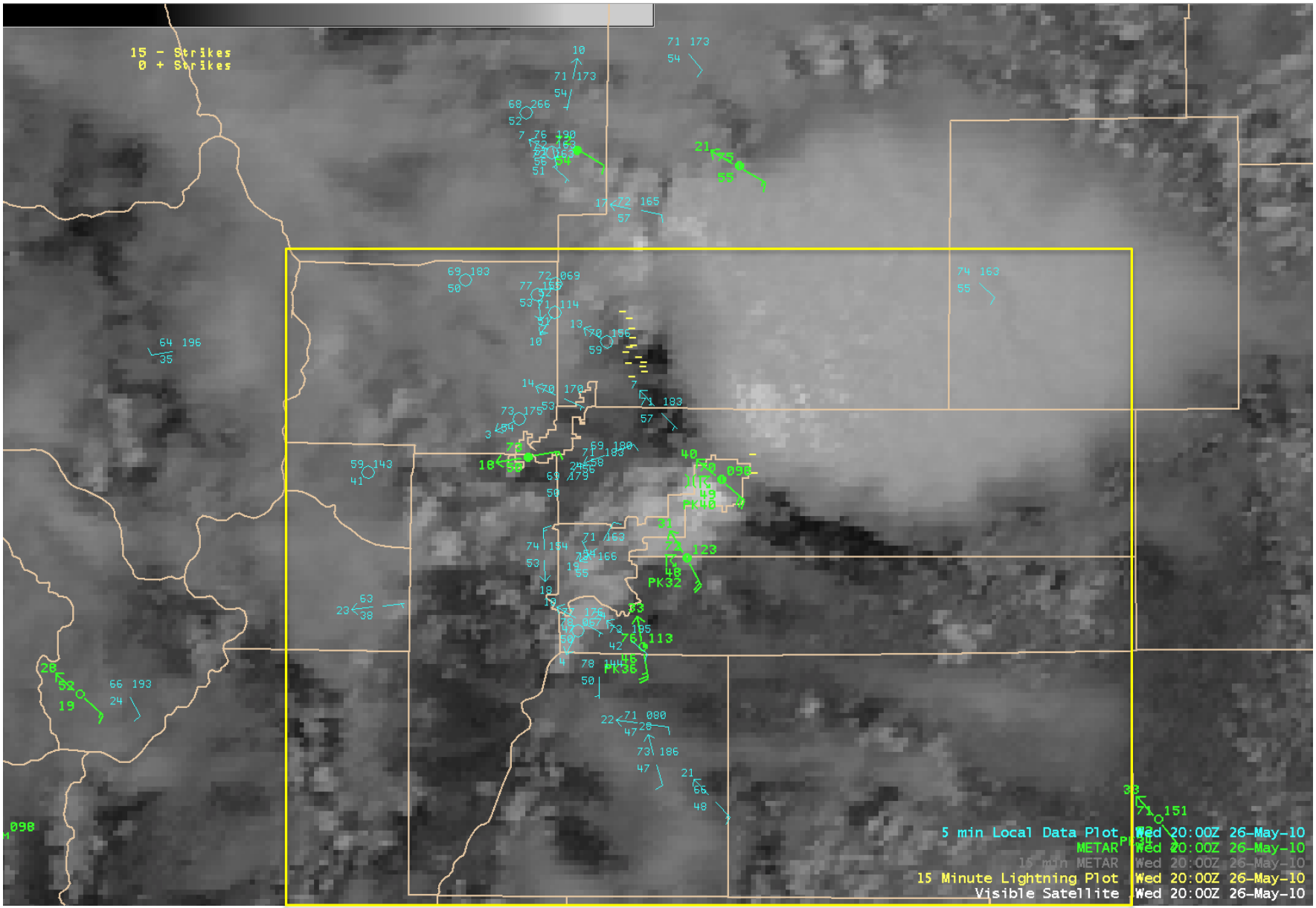


Storm overview – Vis image and obs at 19z; storm developing near DIA



Storm overview – Vis image and obs at 20z

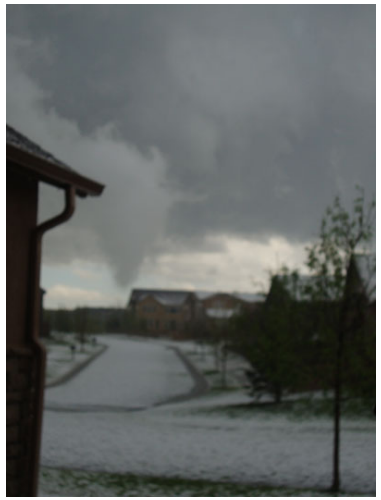
first storm explodes over DIA then slowly moves east



Wall cloud as the storm passes near DIA – not sure of the time of this photo.

Some storm photos – scud or wall cloud? Or funnel? Or tornado??

2 photos of lowering over DIA



2 more photos from near DIA

Photo from Hudson

2 photos from Keenesburg

2 photos from Lochbuie

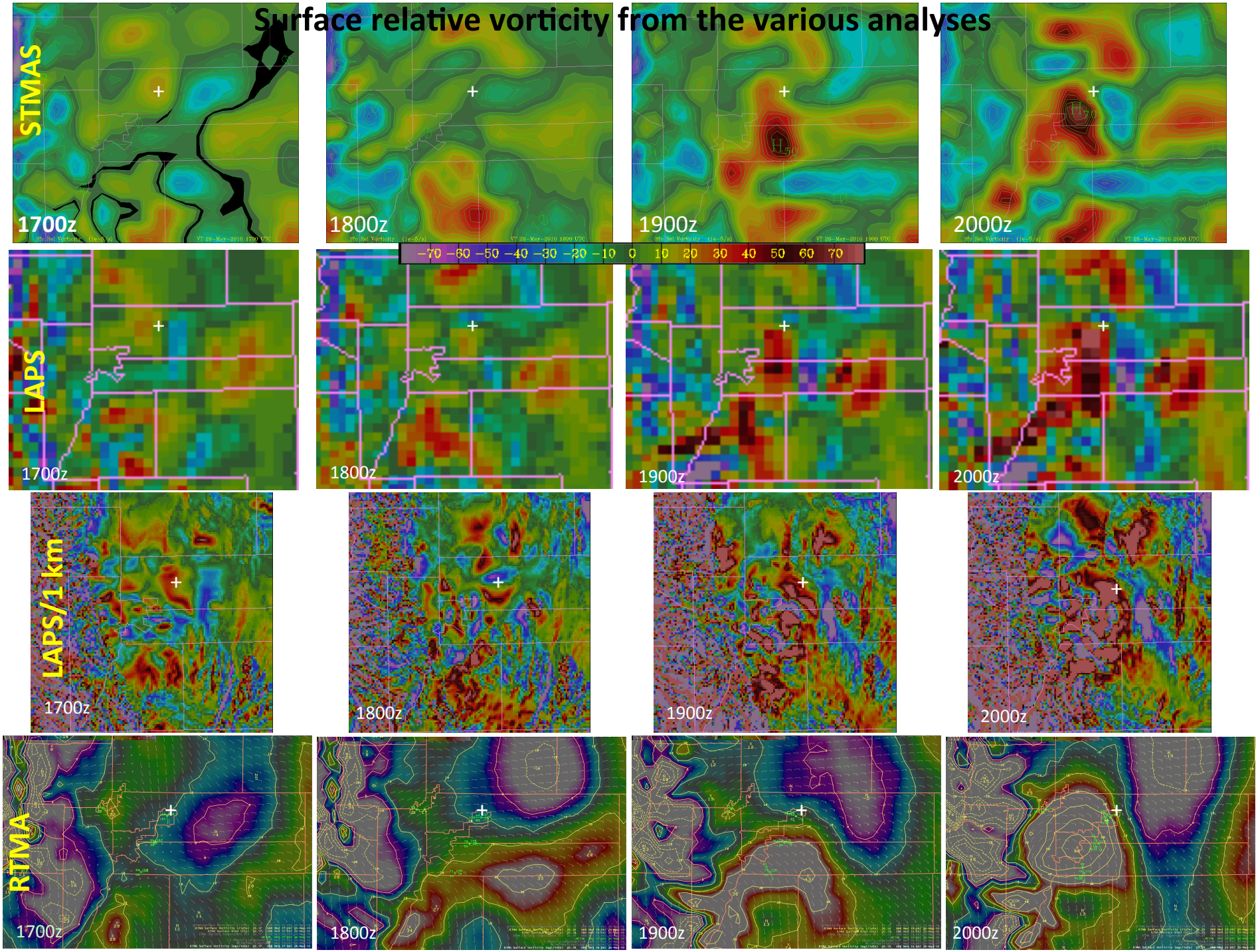
Photo from Watkins

Photo from Wiggins

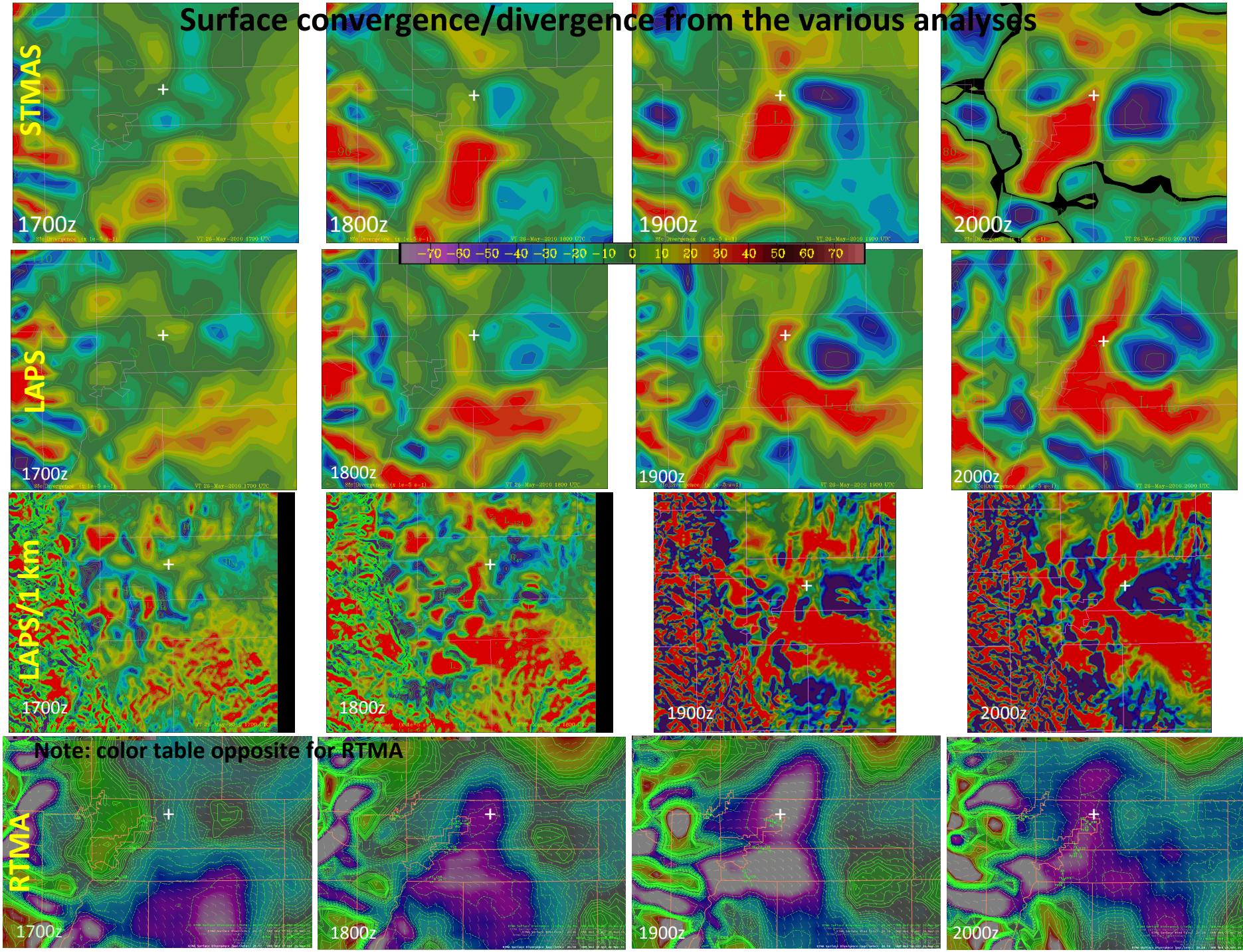
Hail was a big issue with the storm (and subsequent storms)

Areal view of the hail swath near DIA

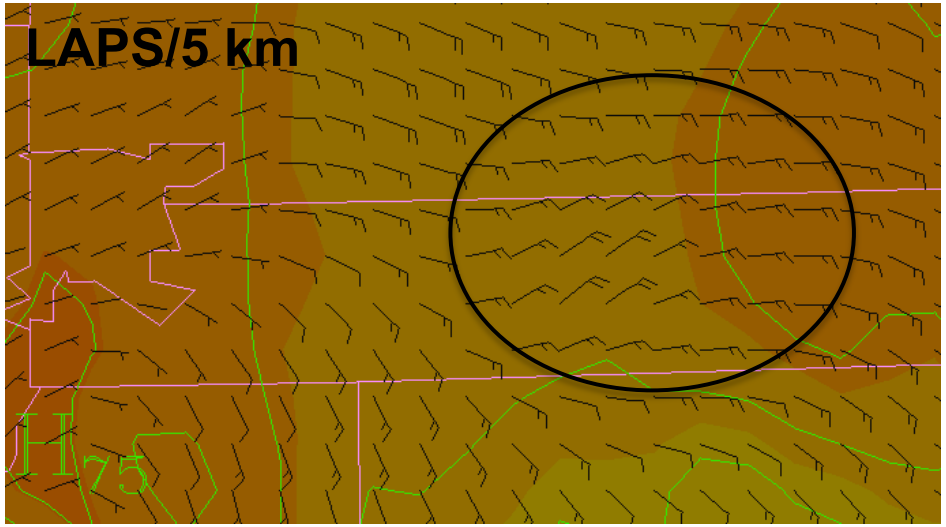
Surface relative vorticity from the various analyses

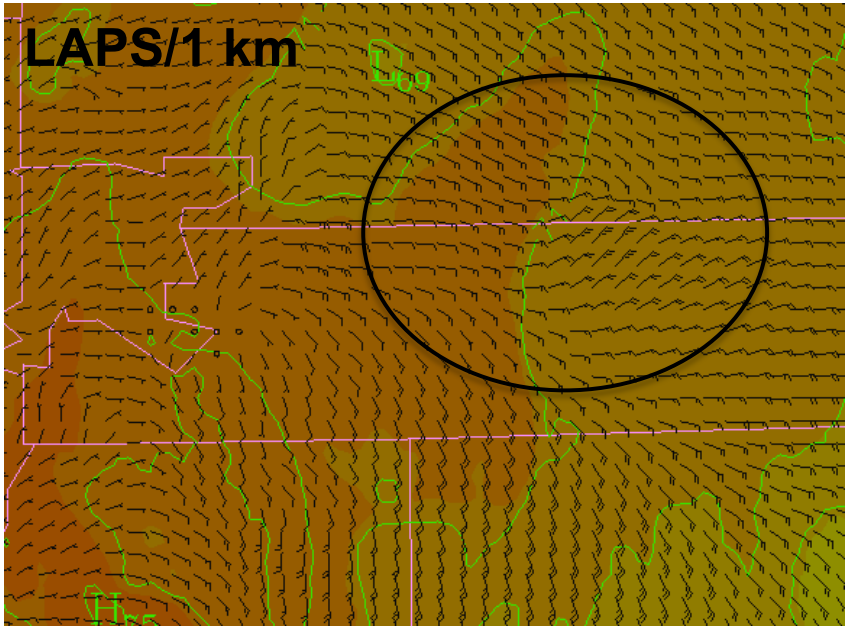


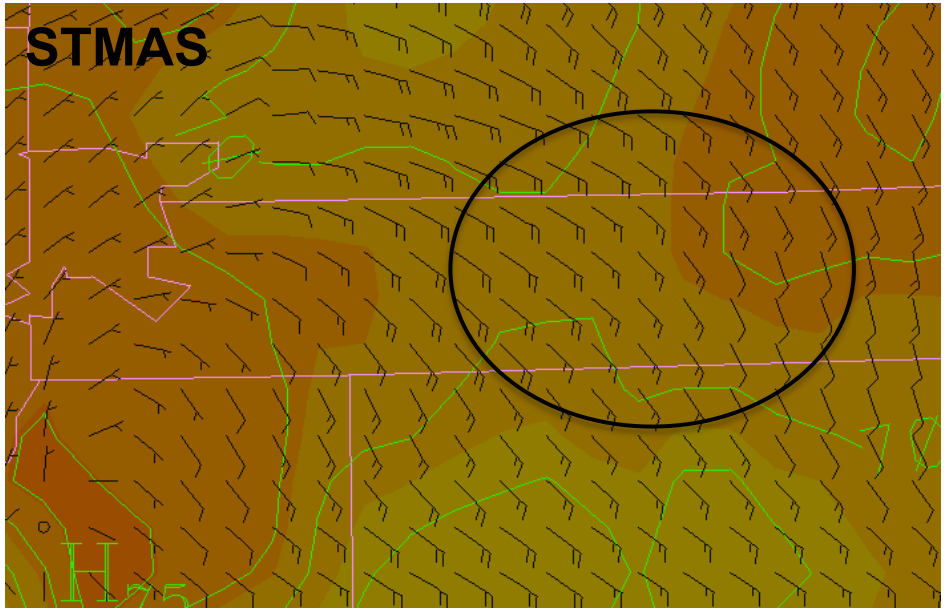
Surface convergence/divergence from the various analyses

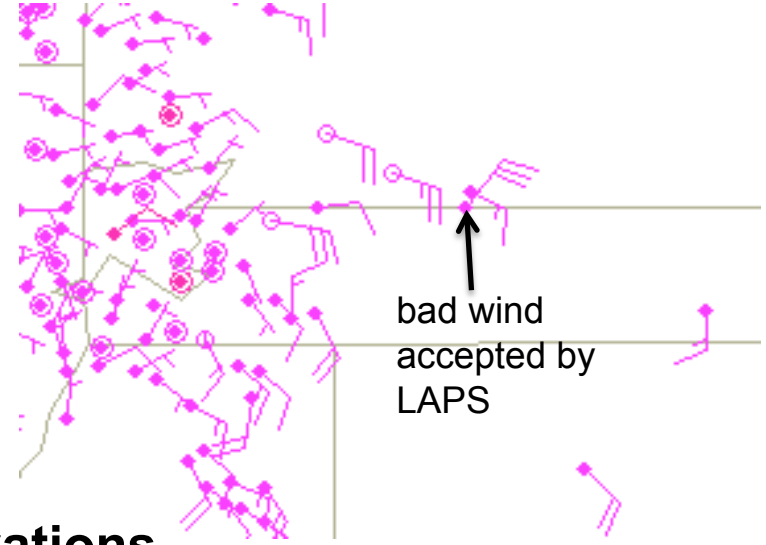


LAPS QC not selective enough – one bad observation produces wind turning.
STMAS did not use this wind and has a good SW wind field.



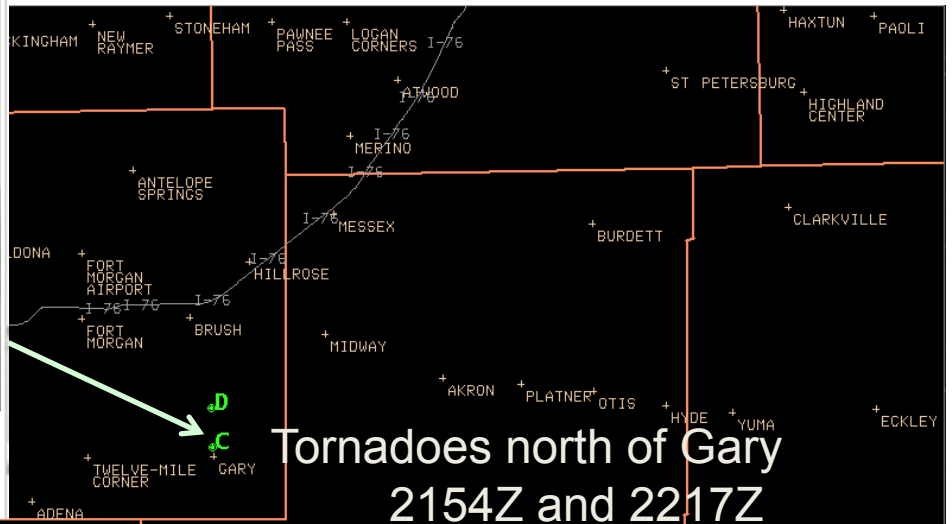




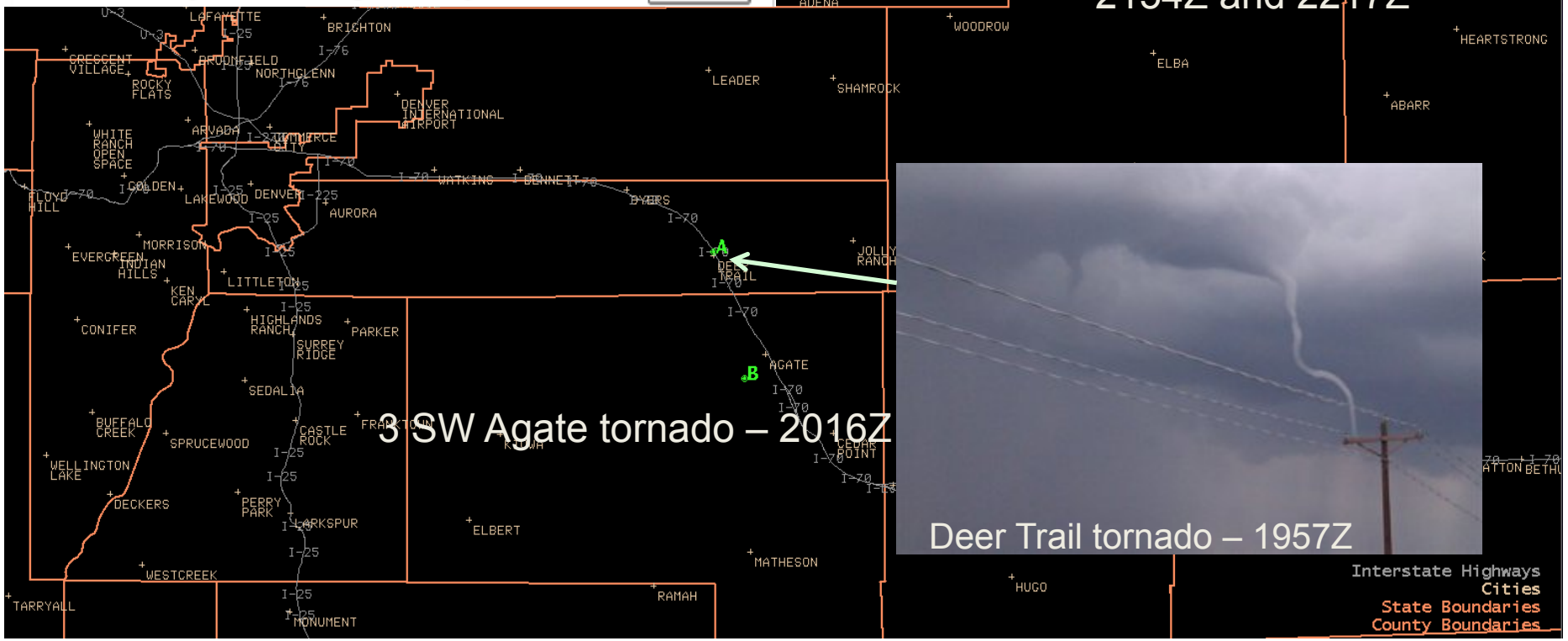


1900z analyses compared to observations

Case 2: Landspouts on 16 Aug 2010



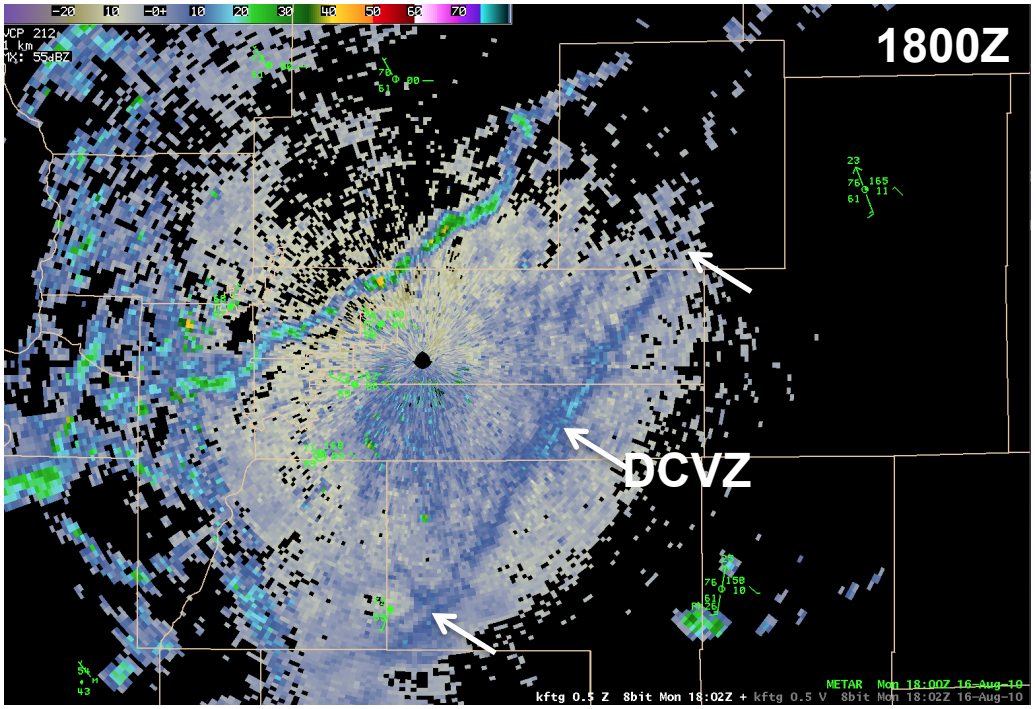
Tornadoes north of Gary
2154Z and 2217Z

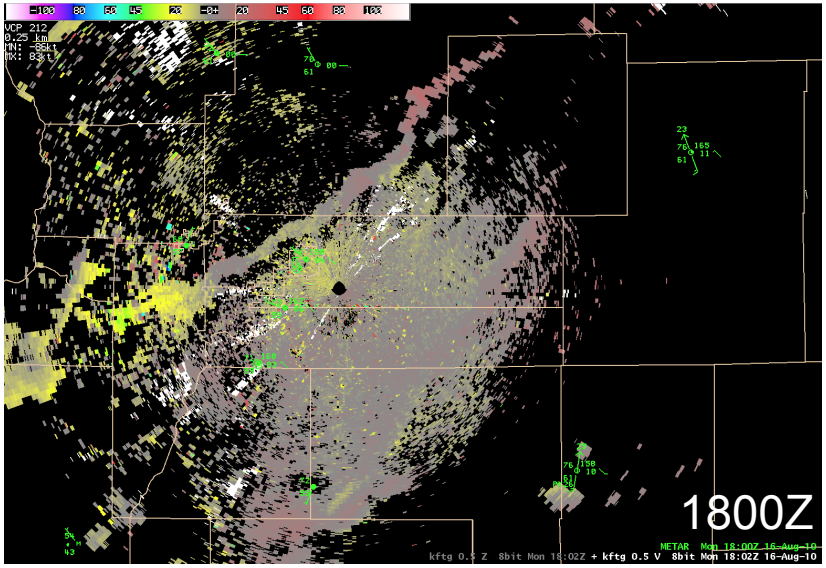


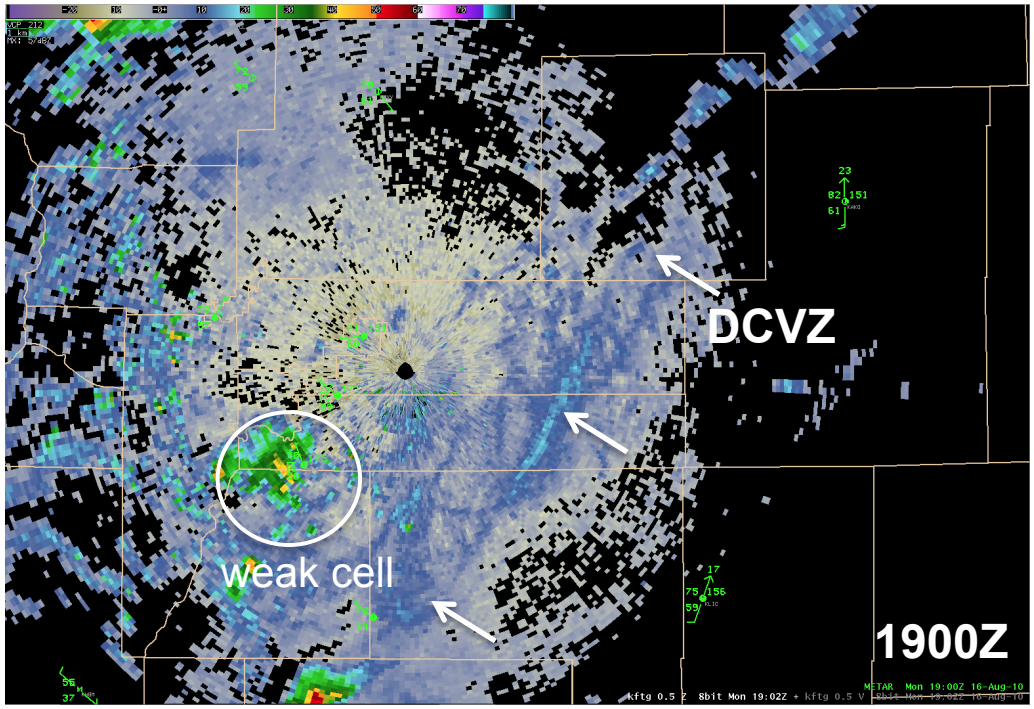
3 SW Agate tornado – 2016Z

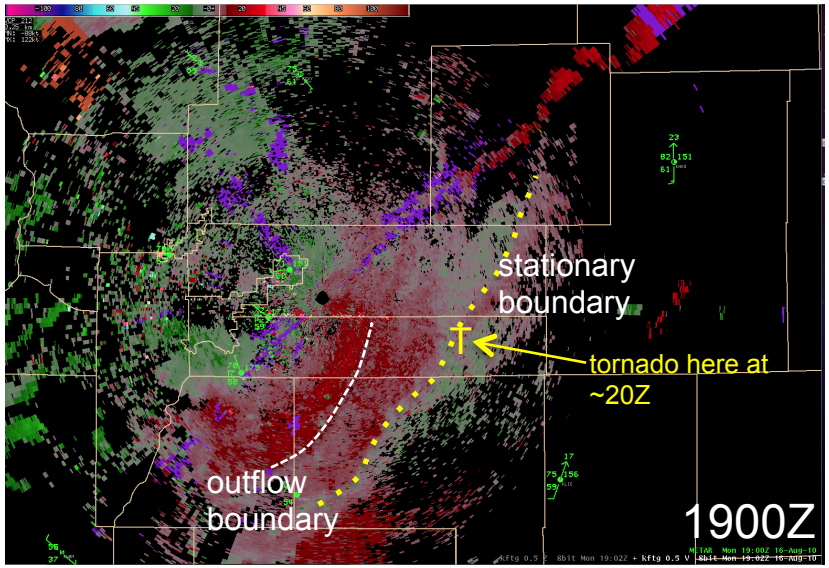
Deer Trail tornado – 1957Z

KFTG reflectivity and velocity overview

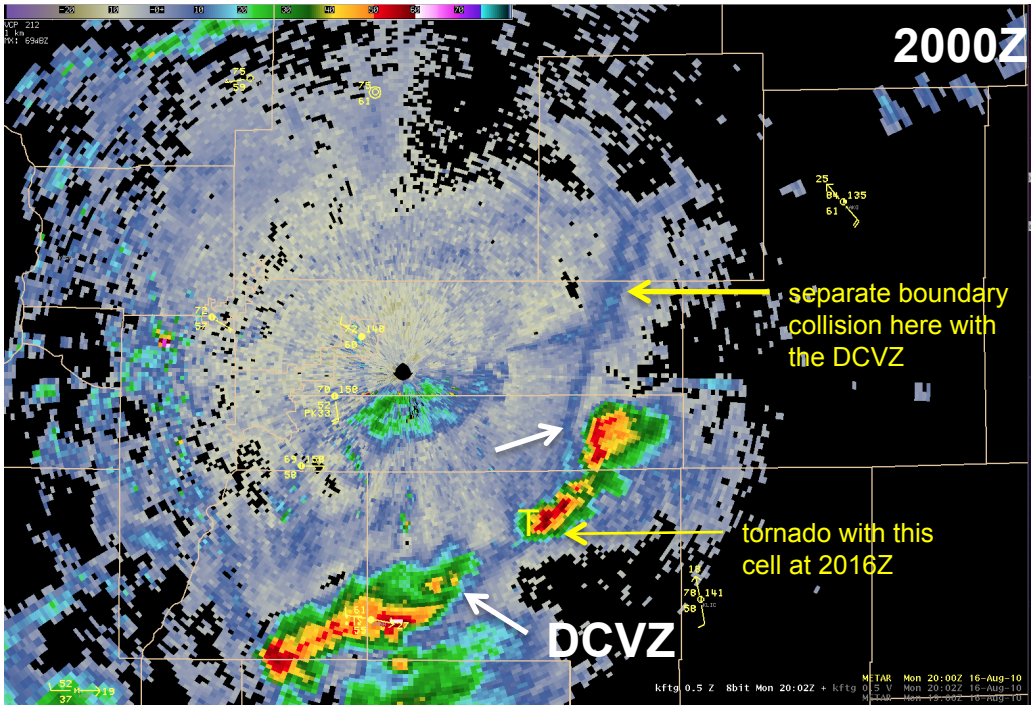


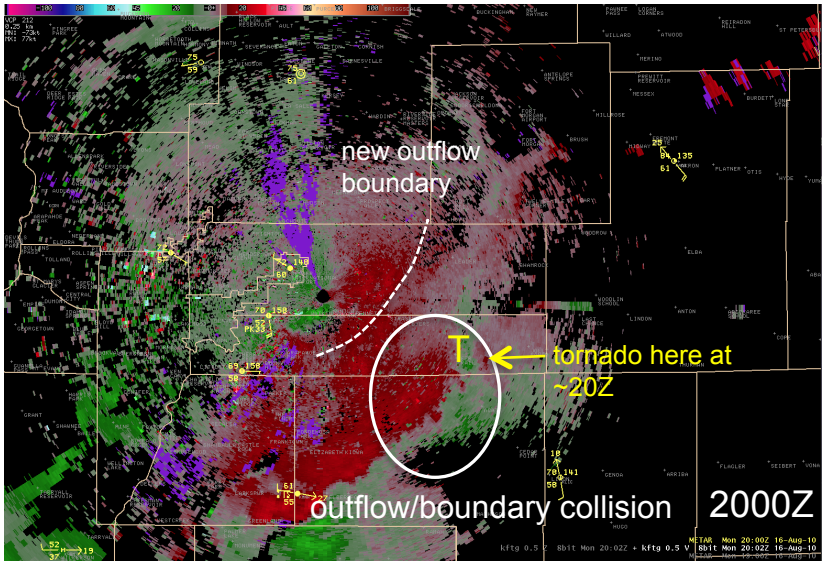


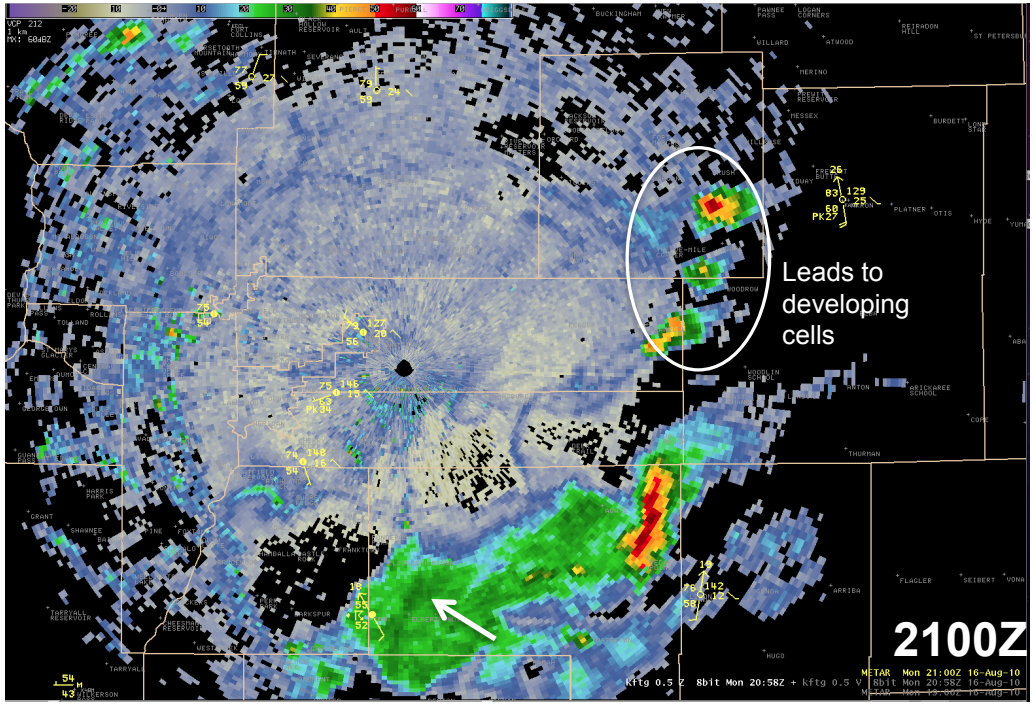


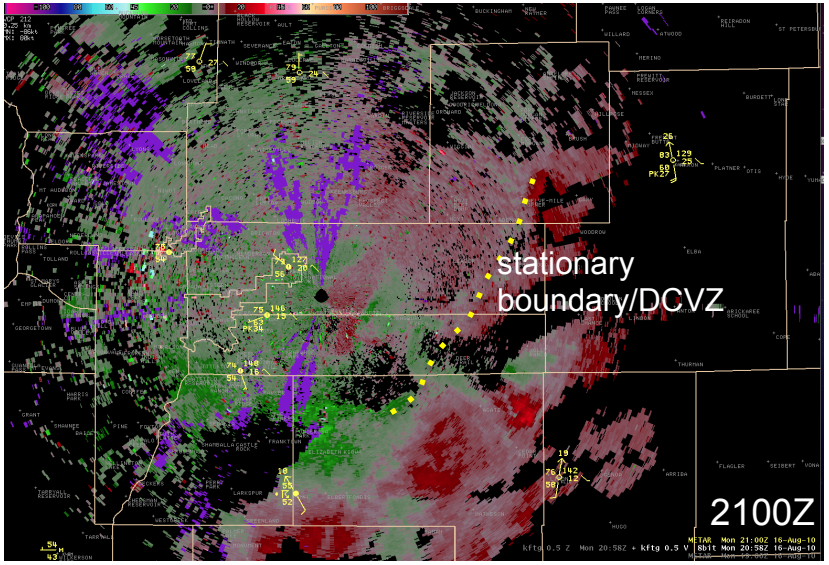


KFTG reflectivity and velocity overview

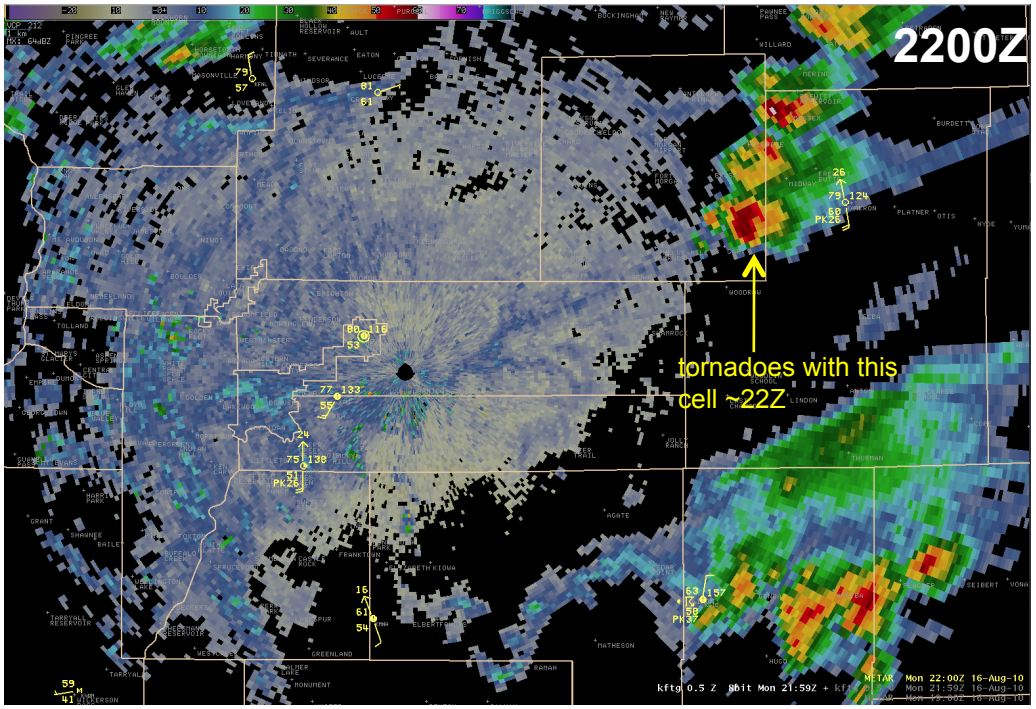


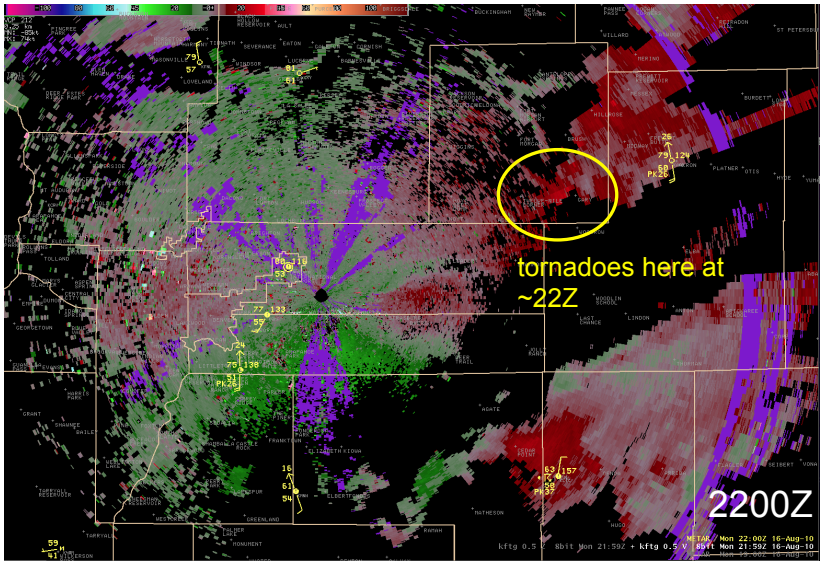


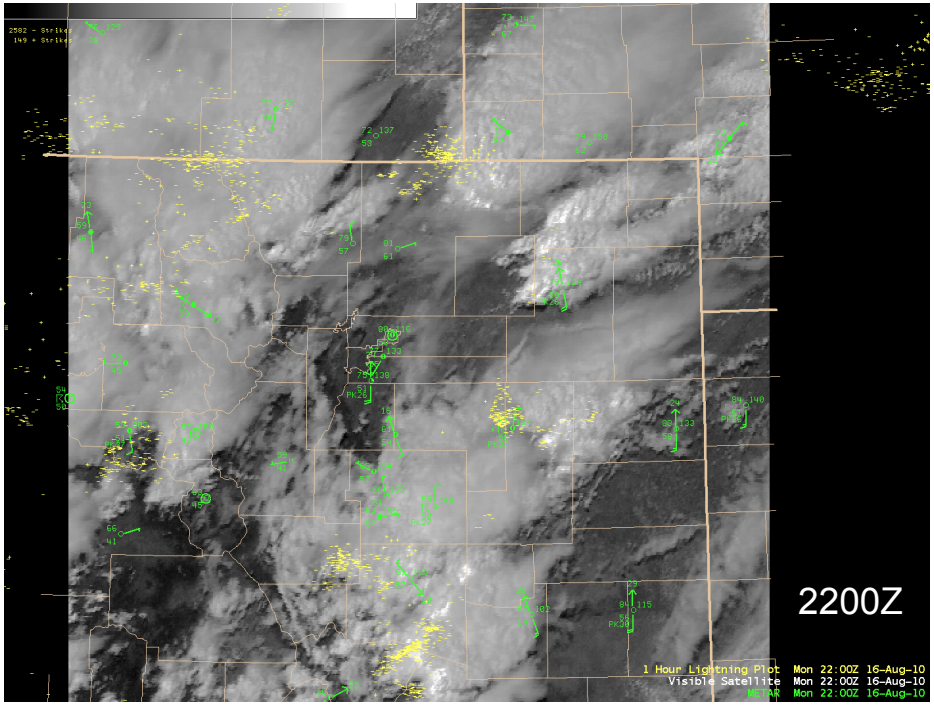


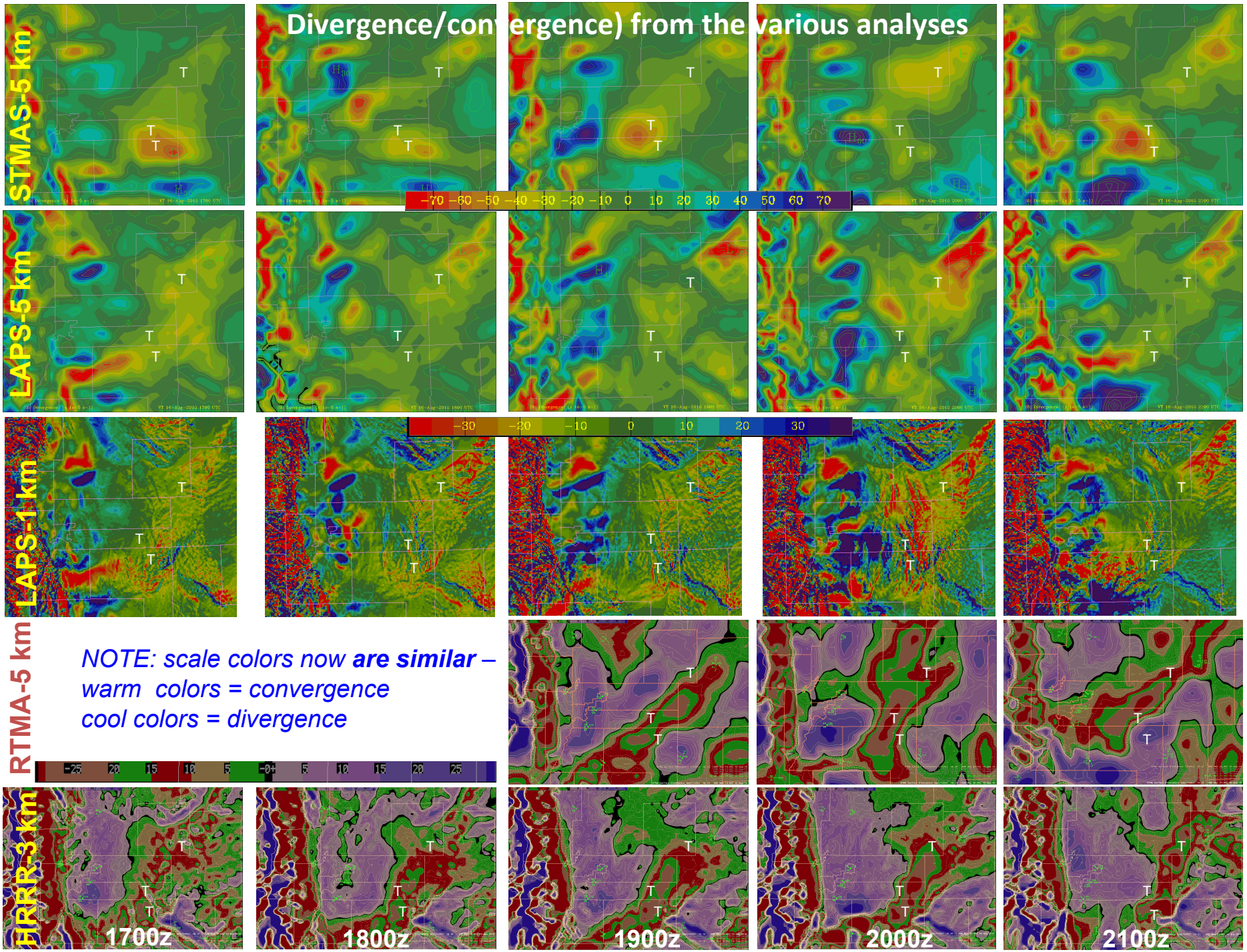


KFTG reflectivity and velocity overview

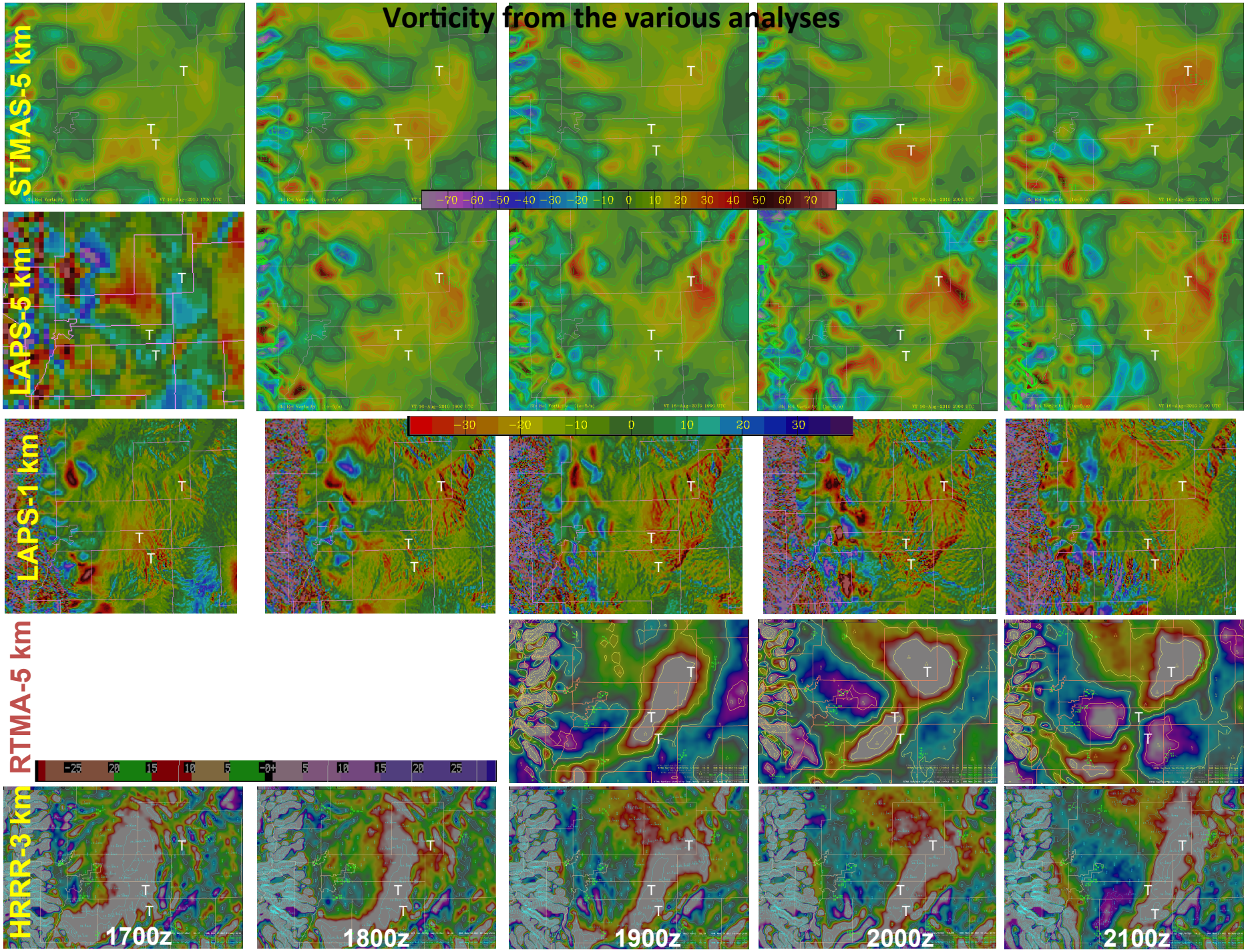






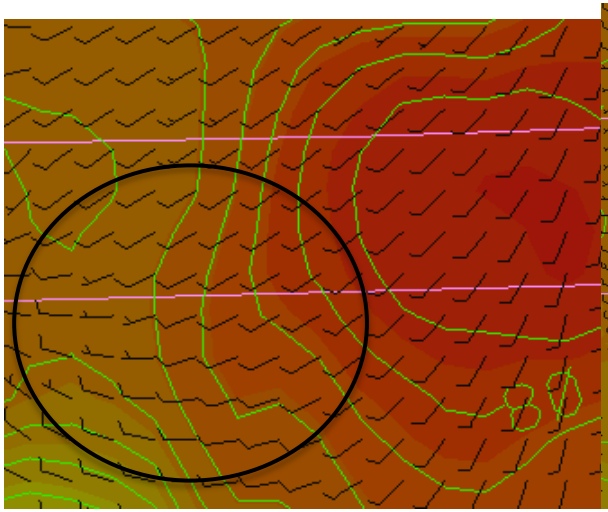

Divergence/convergence) from the various analyses
STMAS-5 km
LAPS-5 km
LAPS-1 km
RTMA-5 km
HRRR-3 km
NOTE: scale colors now are similar –
warm colors = convergence
cool colors = divergence
1700z
1800z
1900z
2000z
2100z

Vorticity from the various analyses

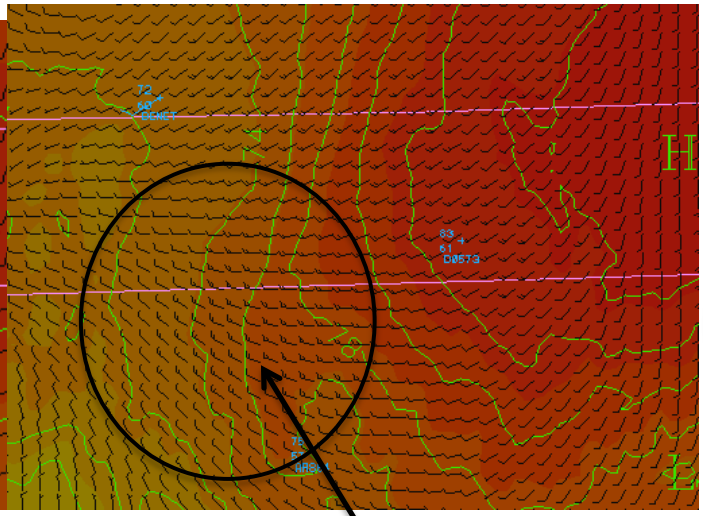


Wind analysis comparison at 2000z– LAPS/1km (which uses Doppler winds) has the strongest NW winds in the circled area closer to what the Doppler velocity indicated. Others tend to be too light, though of these HRRR comes appears to come closest. Very few obs in area circled.

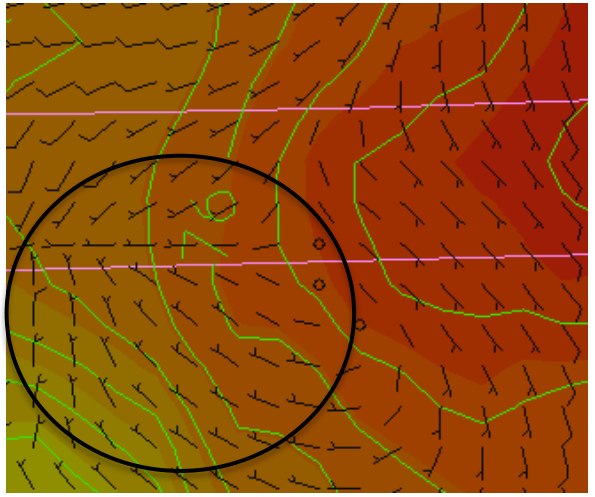
LAPS/5 km



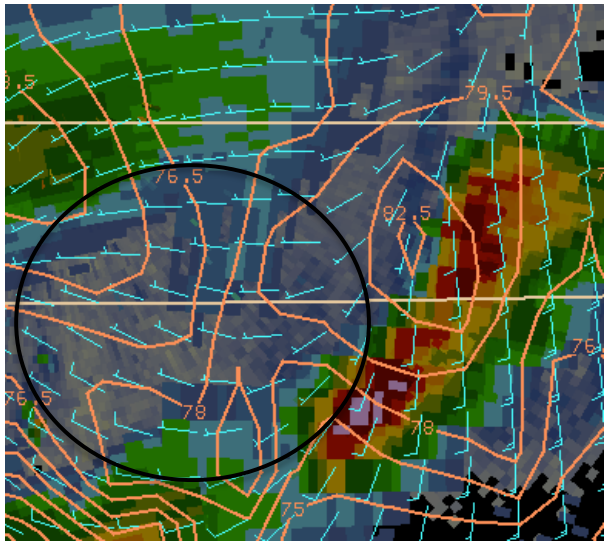
LAPS/1 km



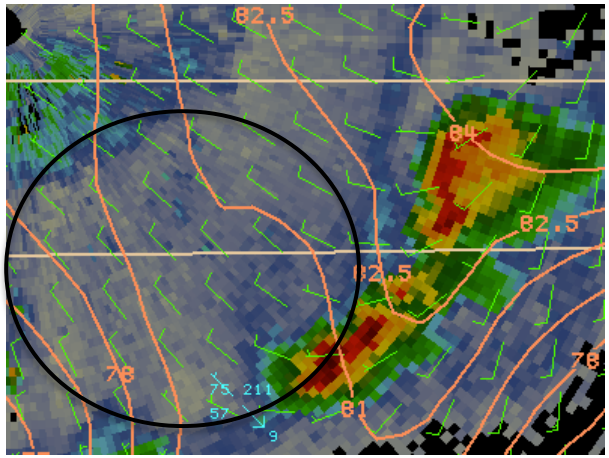
STMAS

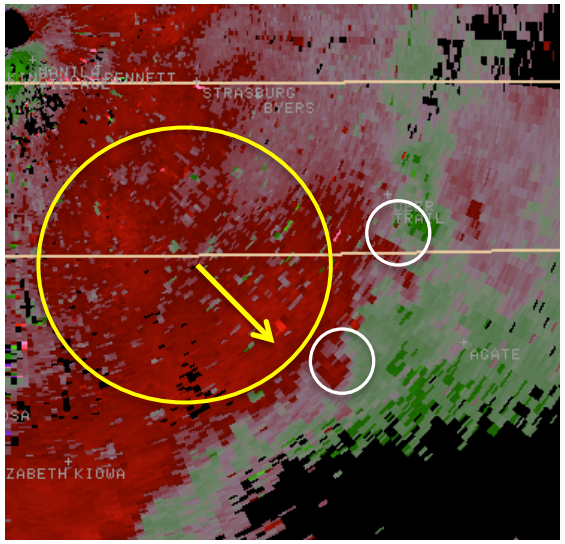


RTMA



HRRR

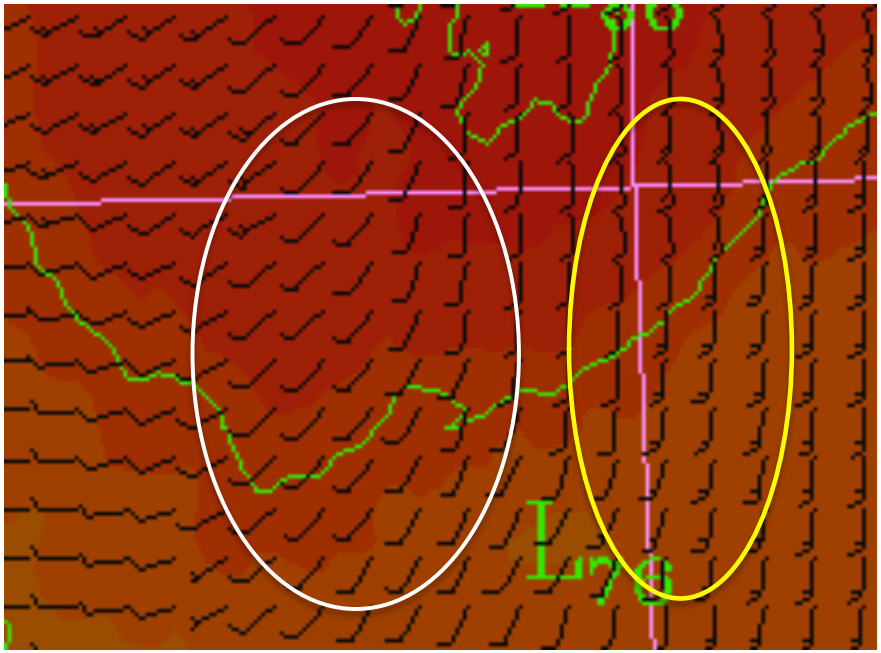


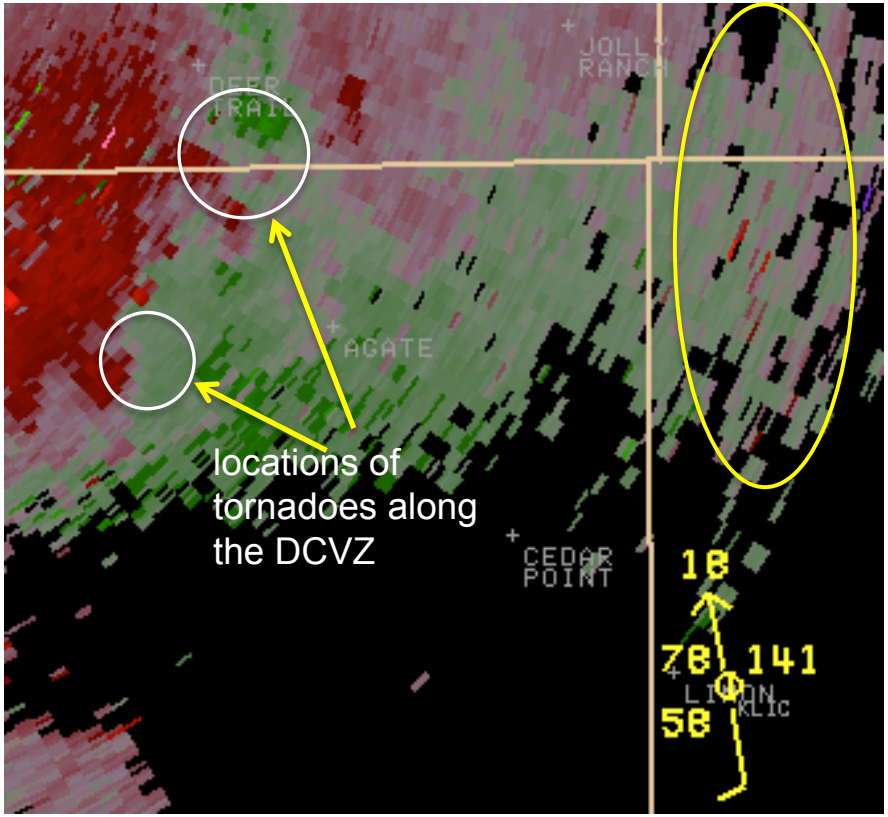


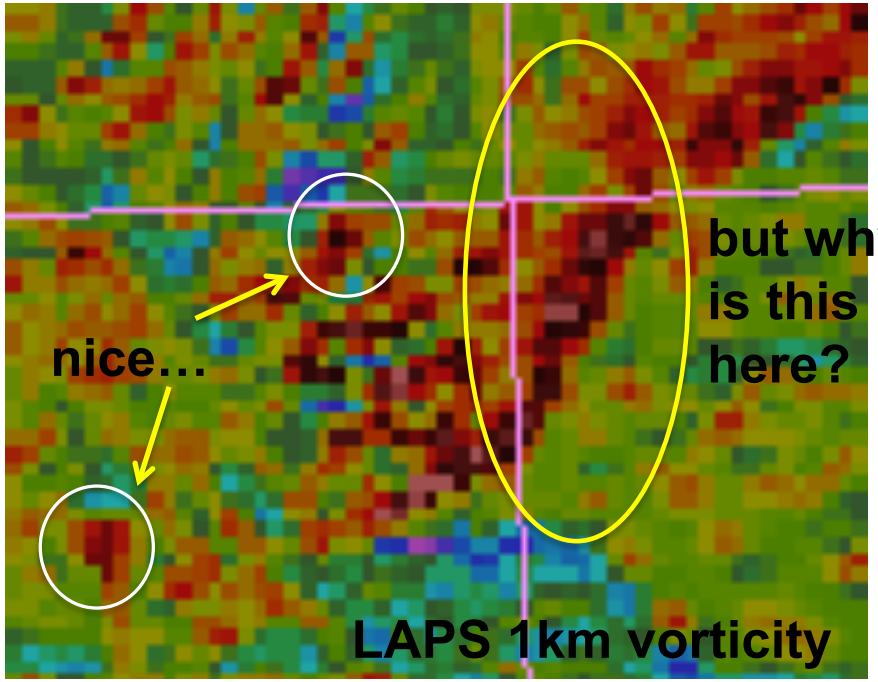
KFTG velocity

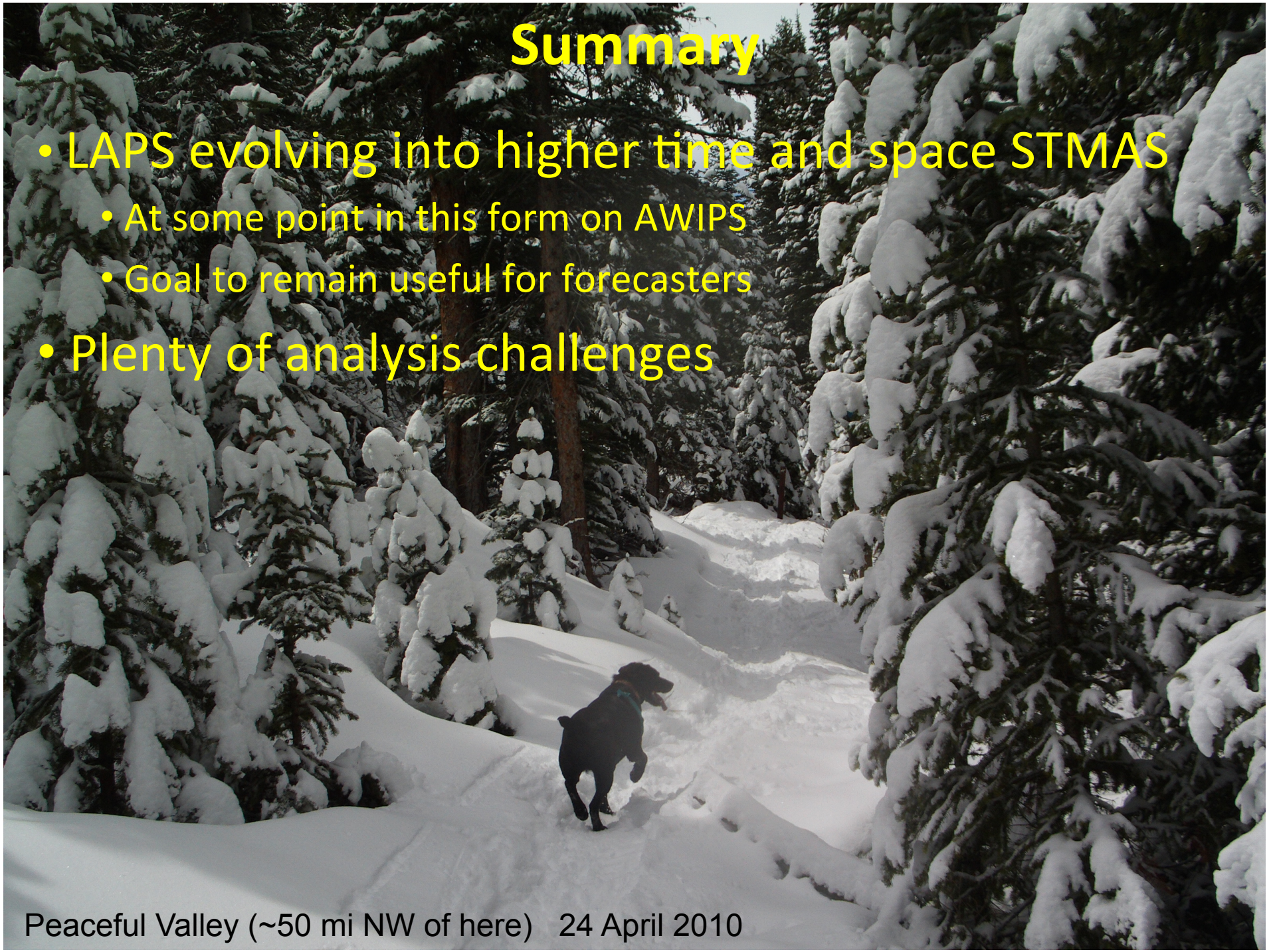
Did LAPS at 1 km resolve the (pre-)tornadic vortices along the DCVZ?

Looks like it did, but, annoying line of concentrated vorticity east of where the action is.



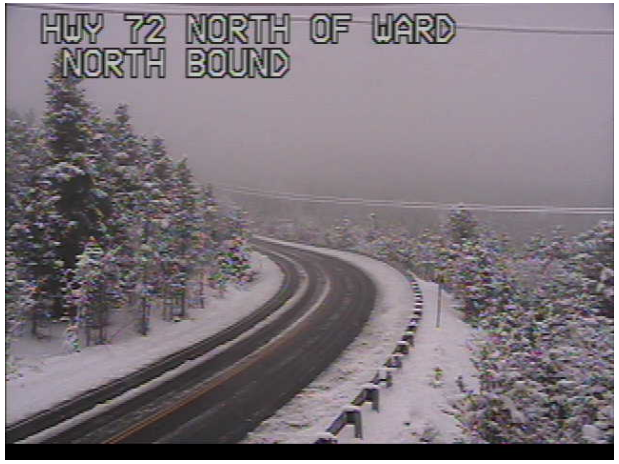





Summary
• LAPS evolving into higher time and space STMAS
• At some point in this form on AWIPS
• Goal to remain useful for forecasters
• Plenty of analysis challenges
Peaceful Valley (~50 mi NW of here) 24 April 2010

Virtual snow chasing mid to late morning on Tuesday

Peak to Peak Highway



I-70

I-70 near
Eisenhower Tunnel

A-Basin ski area – opening soon!